

Appn No. 09/653,149

REMARKS

Claims 1-8, 10-25, and 34-75 are pending in the application with claims 3, 10, and 21 amended herein.

Claims 10, 20, and 21 stand objected to as depending from a canceled claim. Claim 10 is amended herein correcting the claim dependency. However, claims 20 and 21 depend from claim 19 which is currently pending in the present application. Accordingly, no correction of claims 20 and 21 is warranted.

Claim 1 stands rejected under 35 U.S.C. 112, second paragraph, as being indefinite. Applicant requests reconsideration. Page 3 of the Office Action alleges that claim 3 is indefinite regarding whether the conductive barrier layer prevents oxygen diffusion or enhances oxygen diffusion. Applicant asserts that express terms of claim 1 are clear in setting forth "a conductive barrier layer to oxygen diffusion" that prevents diffusion, as supported by page 10, lines 16-23 and elsewhere throughout the present specification. Accordingly, no amendment of claim 1 is warranted. Applicant requests withdrawal of the indefiniteness rejection in the next Office Action.

Claims 1-8, 10-25, and 34-75 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuzumi in view of Kim. Applicant requests reconsideration.

Claim 1 sets forth a capacitor fabrication method that includes, among other features, atomic layer depositing a conductive barrier layer to oxygen diffusion over a first capacitor electrode over a substrate and forming a capacitor dielectric layer over the barrier layer. Pages 3-4 of the Office

Appn No. 09/653,149

Action allege that Fukuzumi discloses every limitation of claim 1 except for forming the conductive barrier layer using ALD and relies upon Kim as allegedly disclosing the missing subject matter. Applicant traverses.

Page 3 of the Office Action states that metal film 52 of Fukuzumi discloses a conductive barrier layer to oxygen diffusion. However, as may be appreciated from page 12, lines 3-7 and elsewhere throughout the present specification, merely forming a metal film does not necessarily constitute forming a barrier layer to oxygen diffusion. Instead, depending upon material properties, at least thickness and density of a metal film may influence whether such film is sufficient to constitute a barrier layer to oxygen diffusion.

Review of Fukuzumi does not reveal any discussion of oxygen diffusion. Applicant acknowledges the discussion in column 15, lines 24-30 of Fukuzumi regarding formation of a conductive oxide at a contact portion between a capacitor electrode and dielectric film. However, such discussion clearly does not address diffusion of oxygen through metal film 52. Fukuzumi does not disclose or suggest any considerations addressing forming metal film 52 in a manner such that it necessarily constitutes a barrier layer to oxygen diffusion. A person of ordinary skill viewing the teachings of Fukuzumi cannot conclude that metal film 52 necessarily constitutes a barrier layer to oxygen diffusion.

The mere fact that a certain thing may result from a given set of circumstances is not sufficient to establish inherency. Instead, some basis in fact and/or technical reasoning must exist to reasonably support the determination that the allegedly inherent characteristic necessarily flows from

Appn No. 09/633,149

the teachings of the applied prior art. No requirement exists that metal film 52 necessarily constitutes a barrier layer to oxygen diffusion. At least for such reason, Applicant asserts that Fukuzumi does not disclose or suggest metal film 52 as a barrier layer to oxygen diffusion.

Page 4 of the Office Action alleges that Kim discloses forming a conductive barrier layer using ALD. However, in this regard, Applicant asserts that Kim fails to remedy the deficiencies of Fukuzumi discussed above. Applicant notes that the problem confronted by the inventor must be considered in determining whether it would have been obvious to combine references in order to solve such problem. If the references do not address or even recognize the problem, then they cannot begin to teach or suggest a solution to it. Neither Fukuzumi nor Kim address the problem of oxygen diffusion solved by Applicant's invention and, accordingly, cannot suggest a solution to such problem.

The Office Action relies upon Kim as allegedly disclosing forming metal film 52 by ALD. However, column 1, lines 8-10 and column 4, lines 8-11 reveal that Kim only addresses formation of a dielectric film by ALD. At least for such reason, Applicant asserts that no suggestion or motivation exists in the prior art to form metal film 52 of Fukuzumi using the dielectric film ALD methods of Kim.

In addition, Applicant asserts that Kim cannot be considered to disclose or suggest any considerations that will necessarily result in metal film 52 constituting a barrier layer to oxygen diffusion. Fukuzumi discloses an Al₂O₃ dielectric film thickness of about 70 Angstroms in column 5, lines 36-39.

Appn No. 09/653,149

Even so, such description does not constitute disclosure of a conductive barrier layer thickness and density sufficient to address oxygen diffusion, such as discussed on page 12, lines 3-7 of the present specification. Thus, neither Fukuzumi nor Kim provide any teaching that metal film 52 of Fukuzumi or the ALD film of Kim are sufficient to produce the atomic layer deposited conductive barrier layer to oxygen diffusion set forth in claim 1.

Page 4 of the Office Action alleges that a conductive barrier layer formed over a capacitor electrode for suppression of leakage current inherently inhibits oxygen diffusion into the electrode. However, as established above, such a conclusion is erroneous. First, the leakage current inhibition described in Kim occurs by virtue of a dielectric layer thickness, not by virtue of a conductive barrier layer thickness. Inhibiting leakage current does not necessarily result in reducing oxygen diffusion. Second, Kim fails to recognize any of the considerations set forth in the present specification that determine whether a conductive barrier layer addresses oxygen diffusion. The deficiency of Kim partly results from failure to recognize the problem resolved by the method of claim 1 and partly from failure to teach ALD of a barrier layer. It follows that no basis in fact and/or technical reasoning necessarily flows from the teachings of Kim to inherently produce a conductive layer that addresses oxygen diffusion, as set forth in claim 1.

In keeping with the statements above, Applicant asserts that neither Fukuzumi nor Kim disclose or suggest a conductive barrier layer to oxygen diffusion. Also, Kim fails to disclose or suggest ALD of a barrier layer, as alleged in the Office Action. At least for such reason, Fukuzumi in view of

Appn No. 09/633,149

Kim fails to disclose or suggest every limitation of claim 1. Claims 2-8, 10-12, and 48-54 depend from claim 1 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested.

For example, amended claim 3 sets forth that the barrier layer has a thickness of from about 200 to about 500 Angstroms. The amendment to claim 3 is supported by page 17, lines 11-12 of the present specification. Neither Fukuzumi nor Kim disclose or suggest a barrier layer having the thickness set forth in claim 3.

Also, for example, claim 10 sets forth ALD of another conductive barrier layer to oxygen diffusion over the dielectric layer. Fukuzumi and Kim do not disclose or suggest and the Office Action does not allege that they disclose or suggest the subject matter of claim 10. Review of both references does not reveal any teaching of another conductive barrier layer to oxygen diffusion.

Further, for example, claims 50 and 51 set forth that the barrier layer contains TiN. Applicant acknowledges a discussion in column 8, line 37 of Kim regarding a lengthy list of materials to which the Kim method applies. However, merely listing TiN as a material does not constitute disclosure or suggestion to replace metal film 52 of Fukuzumi with TiN. The mere fact that the prior art can be modified does not make the modification obvious unless the prior art suggested the desirability of the modification. No support exists in Fukuzumi, Kim, or the Office Action for the desirability of replacing metal film 52 with a metal nitride film. Any proposed modification of the prior art

Appn No. 09/653,149

that renders the prior art device or process inoperable for its intended purpose does not constitute a valid suggestion to modify the reference.

Claim 13 sets forth a capacitor fabrication method that includes, among other features, chemisorbing a layer of a first precursor over a first electrode and chemisorbing a layer of a second precursor on the first precursor layer, a chemisorption product of the first and second precursor layers being contained in a layer of a conductive barrier layer. As may appreciated from the discussion above regarding the deficiencies of Fukuzumi in view of Kim as applied to claim 1, Applicant asserts that such references fail to disclose or suggest the claimed chemisorption product of first and second precursor layers contained in a layer of conductive barrier material.

Claims 14-25 and 55-61 depend from claim 13 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claim 20 sets forth that the barrier layer has a thickness and a density effective to reduce oxidation of the first electrode by oxygen from over the barrier layer. Neither Fukuzumi nor Kim disclose or suggest a thickness and density that reduces oxidation of the first electrode, as set forth in claim 20. Also, for example, claim 21 sets forth that the barrier layer has a thickness of from about 200 to about 500 Angstroms. Also, for example, claims 57 and 58 set forth that the barrier layer contains TiN. As may be appreciated from the discussion above regarding patentability of respective claims 3, 50 and 51, claims 21, 57, and 58 are patentable.

Claim 34 sets forth a capacitor fabrication method that includes, among other features, atomic layer depositing a metal-containing conductive layer over a first electrode containing silicon and forming a capacitor dielectric layer over the conductive layer. As may appreciated from the above discussion regarding the deficiencies of

Appn No. 09/633,149

Fukuzumi in view of Kim as applied to claim 1, such references fail to disclose or suggest ALD of a metal-containing conductive layer, as set forth in claim 34. Specifically, the cited references fail to disclose or suggest a motivation to modify Fukuzumi by replacing metal film 52 with a metal nitride or conductive metal oxide such as listed in column 8 of Kim. No support exists for the proposition that the material of Kim will provide the essential functions of metal film 52 required by Fukuzumi.

Claims 35-39 and 62-68 depend from claim 34 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claims 64 and 65 set forth that the conductive layer contains TiN. Fukuzumi in view of Kim cannot be considered to disclose or suggest replacing metal film 52 with TiN.

Claim 40 sets forth a capacitor fabrication method that includes, among other features, chemisorbing a layer of a first precursor over a first capacitor electrode containing silicon and chemisorbing a layer of a second precursor on the first precursor layer, a chemisorption product of the first and second precursor layers being contained in a layer of a metal-containing conductive material. As may appreciated from the above discussion regarding the deficiencies of Fukuzumi in view of Kim as applied to claim 1, such references fail to disclose or suggest the chemisorption product contained by a layer of metal-containing conductive material set forth in claim 40. Specifically, the cited references fail to disclose or suggest replacing metal film 52 of Fukuzumi with ALD metal nitride of Kim. Claims 41-47 and 69-75 depend from claim 40 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claims 71 and 72 set forth that the

Appn No. 09/653,149

conductive layer contains TiN. As may be appreciated from the above discussion, such claims are patentable.

Applicant herein establishes adequate reasons supporting patentability of claims 1-8, 10-25, and 34-75 and requests allowance of all such pending claims in the next Office Action.

Respectfully submitted,

Dated: 04 Oct 2004

By:


James E. Lake
Reg. No. 44,854